

Dental - Avulsion/Tooth Loss

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Introduction

Avulsion is the complete displacement of a tooth from its socket and is considered a dental emergency. The usual cause is a directed force sufficient to overcome the bond between the affected tooth and the periodontal ligament within the cradling alveolar socket. Avulsion results in hypoxia and eventual necrosis of the pulp. The primary goal of rapid reimplantation is to preserve the periodontal ligament. The following are considerations in patients with avulsed teeth: determine the mechanism of injury, rule out concomitant injuries, and assess for contamination. If the tooth is out of its socket for less than 20 minutes, the prognosis is better. All periodontal ligament cells die if the tooth is out of the socket longer than 60 minutes.^[1] Likely mechanisms of such injury on-orbit are trauma that may occur due to contact with high mass objects during translation. After a traumatic injury, the first priority is to locate the tooth in order to minimize the risk for foreign body aspiration since in microgravity an avulsed tooth could float freely.^{[2][3]} Although terrestrially rapid reimplantation is recommended, returning the tooth to its socket is not recommended during space flight due to the high potential for pulpal infection.^[2]

Clinical Priority and Clinical Priority Rationale by Design Reference Mission

One of the inherent properties of space flight is a limitation in available mass, power, and volume within the space craft. These limitations mandate prioritization of what medical equipment and consumables are manifested for the flight, and which medical conditions would be addressed. Therefore, clinical priorities have been assigned to describe which medical conditions will be allocated resources for diagnosis and treatment. “Shall” conditions are those for which diagnostic and treatment capability must be provided, due to a high likelihood of their occurrence and severe consequence if the condition were to occur and no treatment was available. “Should” conditions are those for which diagnostic and treatment capability should be provided if mass/power/volume limitations allow. Conditions were designated as “Not Addressed” if no specific diagnostic and/or treatment capability are expected to be manifested, either due to a very low likelihood of occurrence or other limitations (for example, in medical training, hardware, or consumables) that would preclude treatment. Design Reference Missions (DRMs) are

proposed future missions designated by a set of assumptions that encompass parameters such as destination, length of mission, number of crewmembers, number of Extravehicular Activities (EVAs), and anticipated level of care. The clinical priorities for all medical conditions on the Exploration Medical Condition List (EMCL) can be found here (https://humanresearchwiki.jsc.nasa.gov/index.php?title=Category:All_DRM). The EMCL document may be accessed here (https://humanresearchwiki.jsc.nasa.gov/images/6/62/EMCL_RevC_2013.pdf).

Design Reference Mission	Clinical Priority	Clinical Priority Rationale
<p>Lunar sortie mission</p> <p>Assumptions:</p> <ul style="list-style-type: none"> 4 crewmembers (3 males, 1 female) 14 days total 4 EVAs/ crewmember <u>Level of Care 3</u> 	Shall	The length of the lunar sortie mission and the types of activities planned are such that dental injuries could potentially occur. Treatment capability shall thus be manifested.
<p>Lunar outpost mission</p> <p>Assumptions:</p> <ul style="list-style-type: none"> 4 crewmembers (3 males, 1 female) 180 days total 90 EVAs/ crewmember <u>Level of Care 4</u> 	Shall	The length of the lunar outpost mission and the types of activities planned are such that dental injuries could potentially occur. Treatment capability shall thus be manifested.
<p>Near-Earth Asteroid (NEA) mission</p> <p>Assumptions:</p> <ul style="list-style-type: none"> 3 crewmembers (2 males, 1 female) 395 days total 30 EVAs/ crewmember <u>Level of Care 5</u> 	Shall	The length of the lunar outpost mission and the types of activities planned are such that dental injuries could potentially occur. Treatment capability shall thus be manifested.

Initial Treatment Steps During Space Flight

A link is provided to a prior version of the International Space Station (ISS) Medical Checklist, which outlines the initial diagnostic and treatment steps recommended during space flight for various conditions which may be encountered onboard the ISS. Further diagnostic and treatment procedures beyond the initial steps outlined in the Medical Checklist are then recommended by the ground-based Flight Surgeon, depending on the clinical scenario. Please note that this version does not represent current diagnostic or treatment capabilities available on the ISS. While more recent versions of this document are not accessible to the general public, the provided version of the checklist can still provide a general sense of how medical conditions are handled in the space flight environment. Medical Checklists will be developed for exploration missions at a later point in time.

Please note this file is over 20 megabytes (MB) in size, and may take a few minutes to fully download.

ISS Medical Checklist (http://www.nasa.gov/centers/johnson/pdf/163533main_ISS_Med_CL.pdf)

Capabilities Needed for Diagnosis

The following is a hypothetical list of capabilities that would be helpful in diagnosis. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.

- Light Source (such as penlight)
- Tongue depressor
- Imaging (such as dental X-ray)

Capabilities Needed for Treatment

The following is a hypothetical list of capabilities that would be helpful in treatment. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.

- Ziploc bag and gloves
- Bandaging
- Analgesics (non narcotic, narcotic, oral, injectable)
- Medication delivery device (dental syringe and needles, Carpuject)
- Antibiotics and anticeptics

Associated Gap Reports

The NASA Human Research Program (HRP) identifies gaps in knowledge about the health risks associated with human space travel and the ability to mitigate such risks. The overall objective is to identify gaps critical to human space missions and close them through research and development. The gap reports that are applicable to this medical condition are listed below. A link to all of the HRP gaps can be found here (<http://humanresearchroadmap.nasa.gov/Gaps/>).

1.01 - We do not know which emerging technologies are suitable for preflight medical screening for exploration missions.

2.01 - We do not know the quantified health and mission outcomes due to medical events during exploration missions.

2.02 - We do not know how the inclusion of a physician crew medical officer quantitatively impacts clinical outcomes during exploration missions. <br 3.01 - We do not know the optimal training methods for in-flight medical conditions identified on the Exploration Medical Condition List taking into account the crew medical officer's clinical background. (Closed)

3.03 - We do not know which emerging technologies are suitable for in-flight screening, diagnosis, and treatment during exploration missions.

4.01 - We do not have the capability to provide a guided medical procedure system that integrates with the medical system during exploration missions.

4.02 - We do not have the capability to provide non-invasive medical imaging during exploration missions.

4.09 - We do not have the capability to provide medical suction and fluid containment during exploration missions.

<br 4.11 - Limited dental care capabilities (Closed)

4.14 - We do not have the capability to track medical inventory in a manner that integrates securely with the medical system during exploration missions.

4.15 - Lack of medication usage tracking system that includes automatic time stamping and crew identification

4.17 - We do not have the capability to package medications to preserve stability and shelf-life during exploration missions. <br

4.24 - Lack of knowledge regarding the treatment of conditions on the Space Medicine Exploration Medical Condition List in remote, resource poor environments (Closed)

4.27 - We do not have the capability to sterilize medical equipment during exploration missions.

5.01 - We do not have the capability to comprehensively manage medical data during exploration missions.

Other Pertinent Documents

List of Acronyms

D	
DRM	Design Reference Mission
E	
EMCL	Exploration Medical Condition List
EVA	Extravehicular Activity
I	
ISS	International Space Station
M	
MB	Megabyte

N	
NEA	Near Earth Asteroid
X	
X-ray	Radiograph

References

1. Peng LF. Avulsed tooth. <http://emedicine.medscape.com/article/763291-overview>, 2009.
2. Hodapp MH. Dental Concerns. In: Barratt M, Pool S, editors. Principles of Clinical Medicine for Space Flight. New York: Springer; 2008. p. 545-57.
3. Marshburn TH. Acute Care. In: Barratt M, Pool S, editors. Principles of Clinical Medicine for Space Flight. New York: Springer; 2008. p. 101-22.

Last Update

This topic was last updated on 8/12/2014 (Version 2).

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